Plasmonics : shaping the density of states at the nanoscale

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The main goal of plasmonics is to couple surface plasmon excitations with nanostructured materials in view of enhancing and controlling light emission and absorption at small length scales and/or short time scales. The field of plasmonics is at a stage where, on the one hand, fundamental studies of light-matter interaction are possible based on almost ideal experiments (*e.g.*, a single emitter interacting with an optical antenna), and on the other hand, the development of real devices is emerging (*e.g.*, in lightning, photovoltaics, information processing, sensing or biomedical imaging and therapy).

In this talk we will review and revisit some fundamental aspects in plasmonics, based on the unifying concept of density of states. Engineering the electromagnetic local density of states (LDOS) in nanostructured environments is a major issue, since the LDOS drives basic processes of light-matter interaction such as spontaneous emission (fluorescence), thermal emission and absorption. We will discuss the concept of LDOS that has become widely used in plasmonics, either to describe basic experiments, or as a central quantity in the engineering of systems with targeted functionalities [1]. Beyond LDOS, we will discuss the concept of cross density of states (CDOS) that permits a description of the intrinsic spatial coherence sustained by the system itself, independently on the excitation conditions [2]. Although the CDOS has been a natural concept in the field of thermal radiation for a long time, it is of much broader interest and, as the LDOS, enters the description of many processes involved in light-matter interaction, such as emission by two fluorescent sources in structured materials [3]. Finally, we will describe recent developments towards the mapping and the characterization of the full LDOS at the nanoscale. We will show that the radiative and non-radiative contributions can be separated [4]. We will also report on a method to quantify the relative weights of the electric and magnetic components included in the local density of states [5]. These are useful steps towards the full electric and magnetic characterization of plasmonic nanostructures and artificial materials for the control of light-matter interaction.

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